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Fish Catch Data from the Landfast Ice of the Mackenzie River Estuary, March 1985, and May 1986, 1987

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by

D.B. Chiperzak, G.E. Hopky and M.J. Lawrence

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This is the 58th Data Report

from the Central and Arctic Region, Winnipeg

PREFACE

This study was funded by the Northern Oil and Gas Action Program (NOGAP), through the Department of Fisheries and Oceans, Central and Arctic Region. It is one of a series of projects being executed under NOGAP B.2, to provide background data for assesing the implications of hydrocarbon development and production on critical estaurine and marine habitats of the Canadian Arctic Coastal Shelf. This document constitutes NOGAP Report B2.42.

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ABSTRACT

Chiperzak, D.B., G.E. Hopky, and M.J. Lawrence. 1991. Fish catch data from the landfast ice of the Mackenzie River estuary, March 1985, and May 1986, 1987. Can. Data Rep. Fish. Aquat. Sci. 847: v + 28 p.

Under-ice sampling for fish was undertaken in the Mackenzie River estuary in March of 1985, and May of 1986 and 1987. Gillnets were set beneath the ice at nine sampling stations of which fish were captured at four of these stations. Largest catches were made off of Tibjack Point (Stations 86031 and 87011) and Toker Point (Station 86030). Fourhorn sculpins, Myoxcephalus quadricornis (Linnaeus), was the only species caught in 1985 and it dominated the catch off Toker Point in 1986. Rainbow smelt, Osmerus mordax (Mitchill), was the most abundant species caught off Tibjack Point in 1986 and 1987. The most abundant coregonid was Arctic cisco, Coregonus autumnalis (Pallas). In all, ten different species were caught over the three year period. Total catch, catch per unit effort, and life history data for fish caught during this study are presented in this report.

Key words: Arctic; coastal waters; Mackenzie estuary; overwintering; life history; Myoxcephalus quadricornis; Osmerus mordax; coregonids.

RÉSUMÉ

Chiperzak, D.B., G.E. Hopky, and M.J. Lawrence. 1991. Fish catch data from the landfast ice of the Mackenzie River estuary, March 1985, and May 1986, 1987. Can. Data Rep. Fish. Aquat. Sci. 847: v + 28 p.

Un échantillonnage du poisson sous la glace a été réalisé dans l'estuaire du fleuve Mackenzie en mars 1985, mai 1986 et mai 1987. Des filets maillants ont été installés sous la glace dans neuf stations d'échantillonnage dont quatre ont permis la capture de poissons. Les prises les plus abondantes ont été réalisées au large de Tibjack Point (Stations 86031 et 87011) et de Toker Point (Station 86030). Le chaboisseau à quatre cornes, Myoxcephalus quadricornis (Linneus), a été la seule espèce capturée en 1985 et a domine les prises au large de Toker Point en 1986. L'éperlan arc-en-ciel, Osmerus mordax (Mitchill), a été l'espèce la plus abondante capturée au large de Tibjack Point en 1986 et 1987. Le corégonidé le plus abondant a été le cisco arctique, Coregonus autumnalis (Pallas). En tout, dix espèces différentes ont été capturées au cours de la période de trois ans. Dans le présent rapport, on trouvera les données sur les prises totales, les prises par unité d'effort et le cycle vital des poissons captures au cours de l'étude.

Mots-clés : Arctique; eaux côtières; estuaire du Mackenzie; hivernage; cycle vital; Myoxcephalus quadricornis; Osmerus mordax; corégonidés.

INTRODUCTION

Fish catch data presented in this report were collected as part of the Beaufort Shelf Fish Habitat Research Subproject (B.2.1). This project was one component of the Critical Arctic Estaurine and Marine Habitat Project (B.2) of the Northern Oil and Gas Action Program (NOGAP).

Fish samples were collected from under the landfast ice (ice that is anchored to the shore) of the Mackenzie River estuary in March of 1985, and May of 1986 and 1987. Temperature, salinity and density data for 1985, 1986 and 1987 are reported in Hopky et al. (1986, 1987 and 1988).

The Mackenzie River estuary and coastal bays provide important overwintering habitat for various freshwater fish species such as inconnu, Stenodus leucichthys (Güldenstadt), Arctic cisco, Coregonus autumnalis (Pallas), and rainbow smelt, Osmerus mordax (Mitchill), and marine species such as saffron cod, Eliginus gracilis (Tilesius), Arctic flounder, Liopsetta glacialis (Pallas), and Pacific herring Clupea harengus pallasi Valenciennes (Kendel et al. 1975; Percy 1975; Bond 1982). Post spawning and nonspawning broad whitefish, C. nasus (Pallas), have also been radio tracked migrating downstream to overwintering sites in Kugmalit Bay and Shallow Bay of the Mackenzie River estuary (K. Chang-Kue, pers. comm.).

To date only a few studies (Galbraith and Hunter 1975; Kendel et al. 1975; Percy 1975; Bond 1982; Lawrence et al. 1984) have conducted under-ice fish sampling in the Mackenzie River estuary or along the Canadian Beaufort Sea coast. The number of sites sampled in these studies have been limited and the fishing effort low. Greater effort has been put into sampling overwintering sites in the delta itself although a paucity of information still exists for this area as well. A synopsis of fish overwintering areas and habitats for the coastal Beaufort Sea and the Mackenzie River delta region has been put together by Sekerak et al. (Draft).

DESCRIPTION OF STUDY AREA

The Mackenzie River estuary encompasses two large bays separated by islands of the outer Mackenzie River delta, Mackenzie Bay to the west and Kugmalit Bay to the east both of which are fed freshwater from the Mackenzie River (Fig. 1). Arms of warm brackish water riding atop the colder more saline waters of the Beaufort Sea stretch past Shingle Point in the west and past McKinley Bay in the east. The distance these arms of brackish water stretch east and west is dependant upon conditions such as river flow and ice cover. During summer the size of the estuary is mainly affected by winds and the Beaufort gyre. In winter it is mostly affected by ice cover and the the horizontal pressure differences associated with it, and the Beaufort gyre. Much of the estuary is shallow, seldom reaching more than six meters of depth. It is covered by ice for aproximately eight months of the year with ice thickness reaching its maximum of 2 - 2.5 m by May. Freeze-up occurs around late October, while break-up usually occurs around the latter part of June.

A detailed description of the geology and geography of the study area is given by Mckay (1963) and the climatology is reviewed in detail by Burns (1973). Temperature and salinities for water under the ice surface, at the pycnocline, and bottom at stations sampled in 1985 and 1987, are given in Table 1. For stations sampled in 1986 one salinity sample was obtained on each of two different dates (Table 1).

METHODS

POSITIONING

In 1985 stations were reached using a DH6 (twin otter) on wheel-skis equipped with Global Navigation System (GNS) positioning equipment.

Trucks were used along an ice road to reach stations in 1986. Positioning was accomplished by identifying nearby shore landforms and aircraft flypasts with a twin otter equipped with GNS positioning equipment.

All stations in 1987 except 87011 were reached using a twin otter aircraft equipped with GNS positioning equipment. Station 87011 was reached by snow machines and positioning took place by visually estimating distance from shore from identifiable shore landforms and from twin otter fly pasts equipped with GNS positioning equipment. Sampling stations and their coordinates are listed in Table 2 and shown in Fig. 2.

FISH CAPTURE

Gillnets were used at all stations. In 1985 and 1986 only bottom sets were made. In 1987 at stations 87009 and 87010, bottom and surface (top of net just below bottom of ice) sets were made. At the remaining three stations in 1987 only bottom sets were made. To deploy nets, 26 cm diameter holes were made in the ice using ice chisels and an electric auger powered by a 3000 watt generator. A modified, World War II torpedo (modifications designed by Frozen Sea Research Group, Institute of Ocean Sciences, Victoria, B.C.) powered by 3 to 4, 12 volt car batteries connected in series was lowered underneath the ice surface and sent off in a course to pass to the left of another hole aproximately 60 m away. Once the torpedo was past and to the left of the hole the polarity of the power to the torpedo was reversed. This action activated a solenoid releasing the left-hand bridle connection so that it would begin

pulling to the right, so as to move across the hole. One person with a hook would catch the cable of the torpedo and pull it up through the hole. A line was then tied to the torpedo's cable and the torpedo was then pulled back to the original hole with the line attached. The line which had been attached to the torpedos' cable was then used to set the net. Nets used were Swedish gillnets, 60 m long by 1.8 m deep and consisted of equal length panels of 10, 19, 33, 45, 55, and 60 mm mesh (bar measure). Sets were made perpendicular to the shore with the 10 mm mesh panel closest to shore. Each set was fished for approximately 24 hours.

In 1986 at station 86030 a trap net was also set for one 24 hour period. The trap dimensions were 1.2 x 1.2 x 1.2 meters and had four leads radiating perpendicular from the trap. Each lead was 30 meters in length. The mesh size (bar measure) for the trap and four leads was 6.4 mm.

LABORATORY TECHNIQUES AND ANALYSIS

Fish were identified with the aid of taxonomic keys and descriptions by Scott and Crossman (1973), and McPhail and Lindsey (1970). A list of species caught is found in Table 3. Fork length or total length (± 1.0 mm) and weight (± 1.0 g) were recorded for all fish caught. In 1985 and 1987 ageing hard parts were taken, stomachs removed and preserved in 10% formalin solution, and sex and maturity recorded. In 1986 the fish were individually wrapped and frozen, for later sampling at the Freshwater Institute laboratory in Winnipeg, where ageing parts, stomachs, sex and maturity were obtained. The sex and maturity code used is given in Table 4. Stomach samples were not analyzed.

A total of 175 fish were aged using otoliths. The otoliths were hand ground on a carborundum and cleared in methyl salicylate. Growth rings were counted with a dissecting microscope using reflected light.

Catch per unit effort (CPUE) is expressed as the number of fish caught per net per hour per station.

RESULTS

CATCH

Two stations were fished in March, 1985, one net set was made at station 85050 and one set at station 85053. At station 85050 three fourhorn sculpin, Myoxcephalus quadricornis (Linnaeus) and two unidentified sculpins (Cottidae) were captured (Table 5). The two unidentified sculpins were both badly damaged by amphipods (Onisimus sp.). This can be a common problem in coastal areas of the Beaufort Sea when fish die in nets shortly after setting or when nets are not checked regularly. Bray (1975) noted an abundance of Pseudolibrotus (Onisimus) glacialis in the Liverpool Bay - Eskimo Lake area and that these amphipods could rapidly destroy netted fish. At station 85053 no fish were captured; however, when the net was pulled it was covered in thin square-shaped platlets of ice. These ice formations may have prevented fish from being captured if indeed fish were present at this site.

In May, 1986, two stations were again sampled but this time closer to shore (Fig. 2). At station 86030 (off Toker Point) six gillnet sets were made capturing 153 fish representing eight species. The most abundant species was the fourhorn sculpin with 96 caught and a CPUE of 0.55 (Table 6). The next most abundant species was Arctic cisco with 20 being caught and a CPUE of 0.12. Other species captured were saffron cod, inconnu, least cisco (C. sardinella Valenciennes), rainbow smelt, Pacific herring and Arctic flounder. One 24 hour set was also made with a trap net but no fish were caught.

Five net sets were made at station 86031 (off Tibjack Point) capturing 67 fish representing seven species. The most abundant species caught was rainbow smelt with 38 being captured and a CPUE of 0.25 (Table 7). Arctic cisco was next with 11 captured and a CPUE of 0.09. Other species captured were fourhorn sculpin, Pacific herring, least cisco and burbot, Lota lota (Linnaeus).

Five stations were sampled in May, 1987, but fish were caught only at one station (87011) off Tibjack Point. Seventy-seven fish representing seven species were caught in the five sets at station 87011. Rainbow smelt was the most abundant species captured with 41 being caught and a CPUE of 0.36 (Table 8). Twelve Arctic cisco were captured, making it the second most abundant species caught at this station. Other species captured were fourhorn sculpin, inconnu, least cisco, burbot and lake whitefish, C. clupeaformis (Mitchill). The surface sets at stations 87009 and 87010 both had ice crystals forming on net panels as previously described for net sets at station 85053 in 1985.

FOURHORN SCULPIN

Fourhorn sculpins were captured in all three years and at all stations where fish were caught. Total length ranged from 135 mm to 365 mm with the majority (62%) of fourhorn sculpins ranging from 190 mm to 229 mm in a combined sample for all three years (Table 9). Fifty-eight fourhorn sculpins were aged and ages ranged from 3 to 13 years (Table 10). Aproximately 69% of these fish were between year classes 5 to 8. The sex ratio of males to females was 1:1 where sex could be determined. Eighty-one percent of the females were spent while only 27% of the males were spent. Sixteen percent of females were immature or maturing while these maturity stages made up approximately 60% of the males examined. Life

history data for all fourhorn sculpins captured are listed in Table 11.

RAINBOW SMELT

No rainbow smelt were caught in 1985. In 1986 rainbow smelt were caught at both stations 86030 and 86031, while in 1987 they were caught only at 87011. At station 86030 ten rainbow smelt were caught of which 78% (n=7) were between 100 mm and 150 mm. Thirty-eight rainbow smelt were captured at station 86031 where all fish measurable were over 200 mm. In 1987 forty-one rainbow smelt were caught at 87011 and 80% of these were over 200 mm, the remaining smelt were between 150 mm and 199 mm (Table 12). Sixty-five rainbow smelt were aged and ages ranged from 3 to 12 years (Table 13). The majority of the smelt (71%) were between 6 to 9 years. The sex ratio of male to female was 1:1. Ninety-five percent (n=38) of the females were mature while the remaining 5% (n=2) were immature. In males 67% (n=26) were mature while 21% (n=8) were immature and 13% (n=5) were recorded as maturing. The earliest age of maturity for females and males was seen at year 5. Life history data for rainbow smelt is listed in Table 14.

PACIFIC HERRING

No Pacific Herring were caught in either 1985 or 1987. In 1986 six herring were caught at station 86030 and one at station 86031. Herring ranged in size from 231 mm to 358 mm, their length frequency is shown in Table 15. Four herring were aged and these fish ranged from age class 9 to 12. Sex and maturity was recorded for five herring of which three were mature females. The other two were males one of which was mature and the other maturing (Table 16).

SAFFRON COD

Saffron cod were only caught at station 86030 where 13 were captured. Lengths ranged from 345 mm to 442 mm, with 46% (n=6) falling within the length intervals 390-399 mm (Table 17). Ten saffron cod were aged with ages ranging from 9 to 14 years. Sex and maturity were recorded for six individuals, all of which were male. Only one of these was mature, maturity was not recorded for one individual while the remaining four were either immature or maturing (Table 18). Weights for all saffron cod including total gonad weight for three saffron cod are also given in Table 18.

BURBOT

Four burbot were captured in 1986 at station 86031 and three captured in 1987 at station 87011. Length frequency distributions are given in Table 19. Lengths ranged from 666 mm to 770 mm in a combined sample of both years. Ages ranged from 10 to 13 years. In 1986 sex and maturity was recorded for three burbot of which all three were male, two being immature the other maturing. In 1987 one of the three burbot was a maturing male and the other two were females, one spent and the other maturing (Table 20).

ARCTIC FLOUNDER

Only one Arctic flounder was caught and that was at station 86030. It was 139 mm in total length and weighed 34 g.

INCONNU

Inconnu were caught at stations 86030 and 86031 in 1986 and at 87011 in 1987. Fork lengths ranged from 295 mm to 770 mm in a combined sample for the two years. Length frequency distributions by station are given in Table 21. Nine inconnu from 1986 were given to NOGAP Project B.3 for genetic studies, and additional life history data for these fish are reported in Reist (1987). One immature male from 1986 was aged at seven years. In 1987 five inconnu were females the remaining four were males. Two of the females were spent while the other three were either immature or maturing. All four males were either immature or maturing (Table 22). Ages in 1987 ranged from 8 to 14 years.

ARCTIC CISCO

Arctic cisco were the third most abundant species captured in the three years of under-ice sampling but the most abundant coregonid species. At all three stations where Arctic cisco were captured the majority (64%) were all over 300 mm (Table 23). The range for all fish sampled was from 179 mm to 360 mm. Samples from 1986 were donated to NOGAP Project B.3 for genetic studies, and additional life history data for these fish are reported in Reist (1987). Two fish were aged and maturities and sex recorded. Both were immature males one in year class 4 the other in year class 8. Five Arctic cisco were damaged by Onismus sp. amphipods and so no measurements were taken.

In 1987 all 12 Arctic cisco were examined for sex and maturity. Nine were males of which seven were immature and two were maturing. Of the three females one was spent, another mature while the last one was recorded as maturing (Table 24). In 1987 ages ranged from 5 to 11 years. Weights for left and right gonads are also given in Table 24.

LEAST CISCO

One least cisco was captured at station 86030 and two at station 86031. In 1987 three least cisco were captured at station 87011. Fork lengths ranged from 172 mm to 282 mm in a combined sample of both years. Least ciscoes in 1986 were donated to NOGAP Project B.3

for genetic studies, and additional life history data can be found in Reist (1987). In 1987 two least ciscoes were recorded as immature males and another as a maturing female. Ages ranged from year class 6 to 8. Left and right gonad weights for 1987 least ciscoes are listed in Table 25.

LAKE WHITEFISH

Lake whitefish were captured only in 1987 at station 87011 where three were caught. Lengths ranged from 309 to 325 mm. Sex and maturity was determined on only two lake whitefish. One was an immature male the other a maturing female. One whitefish was in year class 7 and the other two in year class 9. Left and right gonad weights are given in Table 26.

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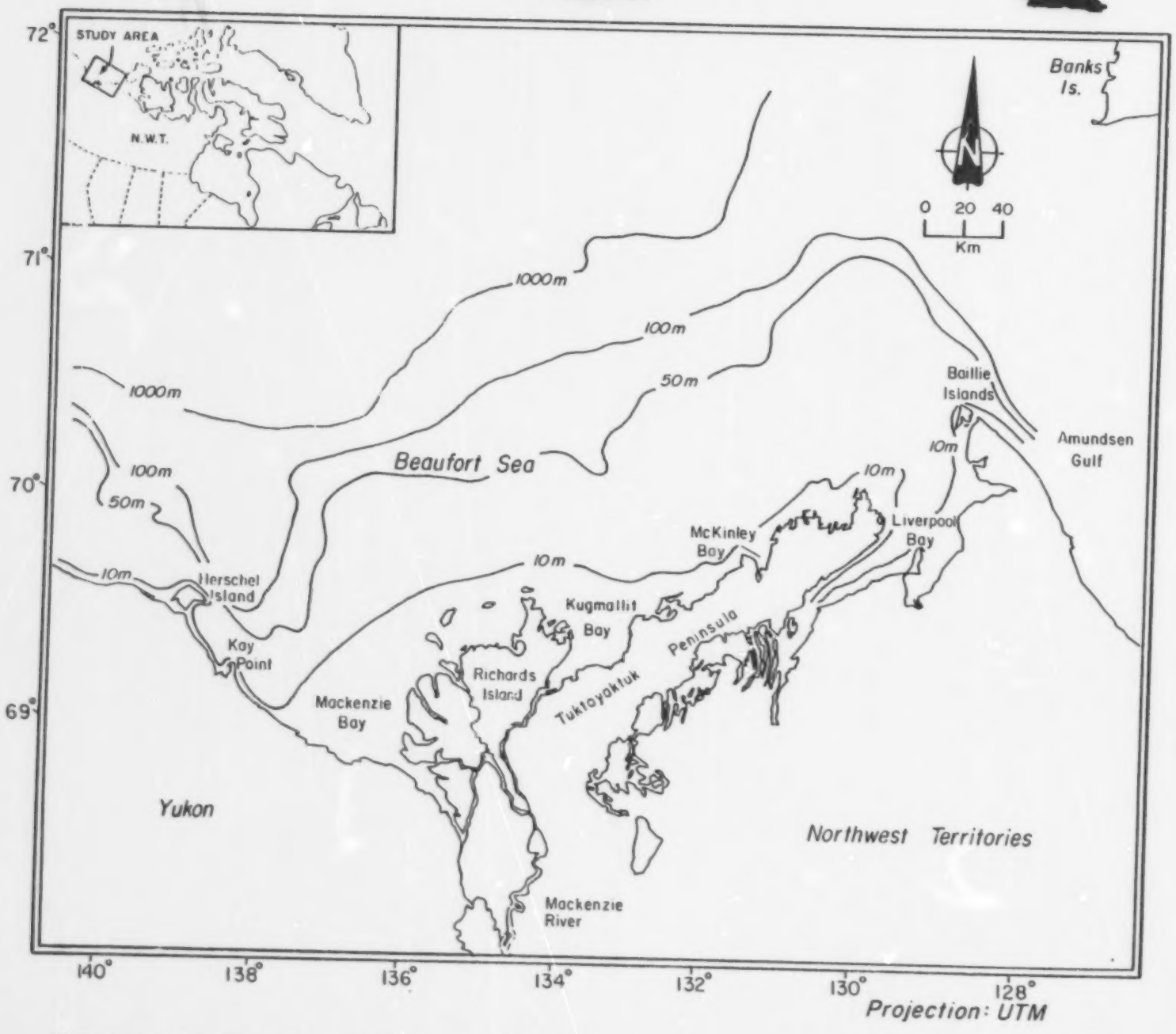

Figure 1. Location and detailed map of Beaufort Sea/Mackenzie River estuary study area.

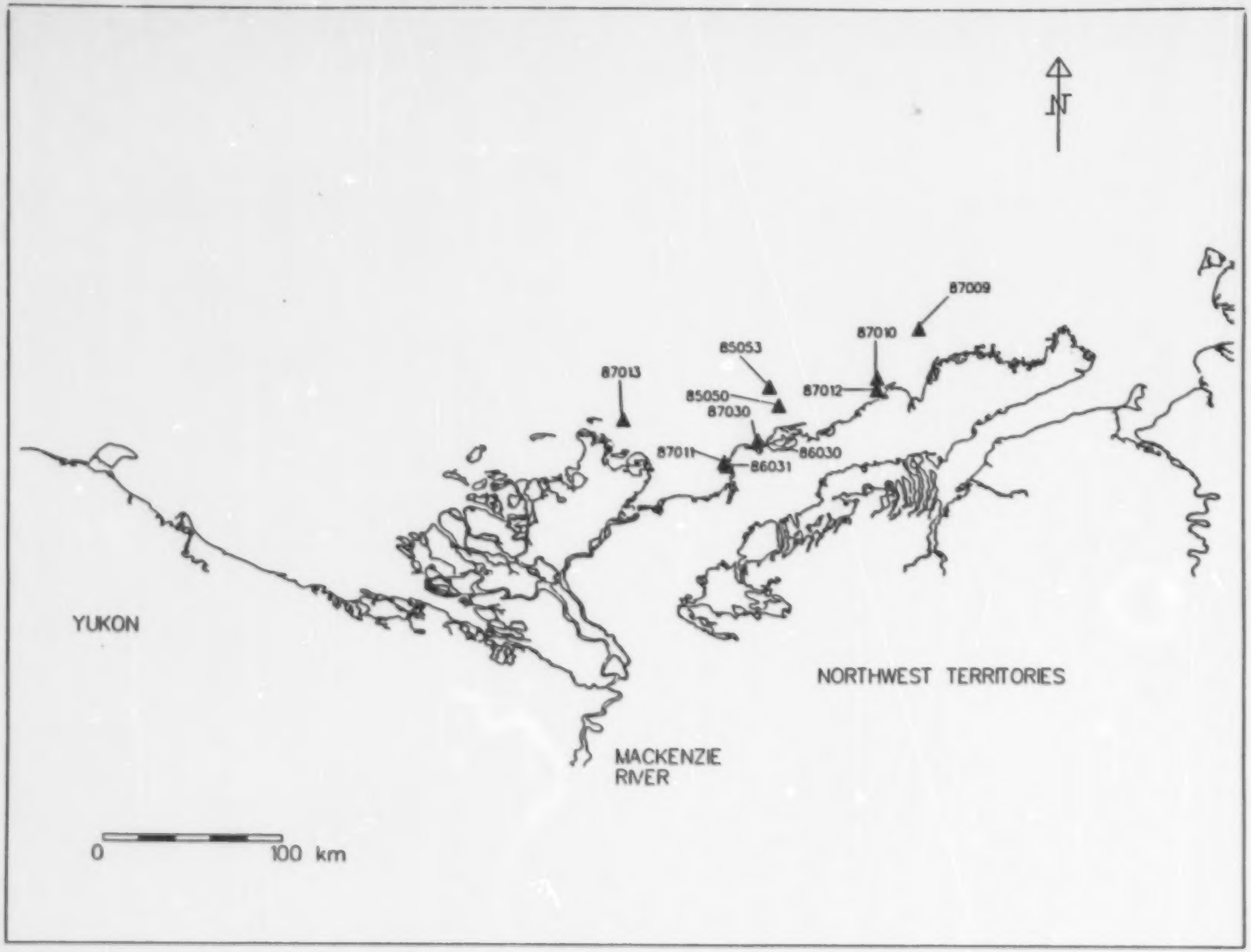

Figure 2. Stations sampled in March 1985, and May 1986, 1987.

Table 1. Temperature and salinity readings from under-ice fishing stations sampled in 1985, 1986 and 1987.

Station	Date	Depth	Temperature	Salinity
85050	March 24/85	1.9	-0.42	4.79
		6.4	-0.56	18.93
		8.8	-0.85	28.53
85053	March 26/85	2.5	-0.59	10.25
		7.3	-1.53	18.27
		13.9	-1.71	26.22
86030	May 17/86	3.0		0.54
	May 19/86	5.0		0.36
86031	May 17/86	3.0		0.23
	May 19/86	4.8		0.23
87009	May 12/87	1.8	-0.40	7.26
		5.5	-1.09	19.02
		16.3	-1.69	31.63
87010	May 12/87	2.0	-0.14	2.44
		5.9	-1.01	21.16
		12.1	-1.58	30.29
87011	May 13/87	1.6	0.00	0.13
		4.8	0.00	0.13
87012	May 17/87	1.6	-0.17	3.02
		5.6	-0.63	21.22
		6.3	-0.73	24.20
87013	May 19/87	2.0	-0.14	2.47
		4.8	-0.18	3.19

Data from Hopky et al. (1986, 1987 and 1988)

Table 2. Station summary for all under-ice fishing stations sampled in the Mackenzie River estuary, 1985 - 1987.

Station	Latitude Deg	Min	Longitude Deg	Min	Dates Sampled	Set Type	Total Depth	Ice Depth	Number of Sets	Comments
85050	69	51.0	132	31.0	March 26 - 27	Bottom	10	2.0	1	
85053	69	56.5	132	36.5	March 26 - 27	Bottom	15	2.0	1	No catch, ice cyrstals
86030	69	40.4	132	43.2	May 13 - 14	Bottom	6	2.0	1	Trapnet, no catch
86030	69	40.4	132	43.2	May 16 - 23	Bottom	6	2.0	6	
86031	69	32.8	133	01.5	May 17 - 23	Bottom	5	2.2	5	
87009	70	14.3	131	7.4	May 13 - 18	Surface	18	1.7	3	No catch, ice crystals
87009	70	14.3	131	7.4	May 13 - 18	Bottom	18	1.7	3	No catch
87010	69	59.3	131	32.3	May 14 - 19	Surface	13	1.7	3	No catch, ice crystals
87010	69	59.3	131	32.3	May 14 - 19	Bottom	13	1.7	3	No catch
87011	69	33.8	133	3.0	May 19 - 23	Bottom	6	1.6	5	
87012	69	55.8	131	32.4	May 22 - 24	Bottom	7	1.6	3	No catch
87013	69	46.5	134	2.7	May 25	Bottom	5	1.8	1	No catch

Table 3. Species code, scientific and common names of fish captured in the Mackenzie River estuary, using gillnets, 1985 - 1987.

Species Code	Scientific Name	Common Name
ARCS	Coregonus autumnalis (Pallas)	Arctic cisco
LSCS	Coregonus sardinella Valenciennes	Least cisco
LKWF	Coregonus clupeaformis (Mitchill)	Lake whitefish
INCO	Stenodus leucichthys (Guldenstadt)	Inconnu
RNSM	Osmerus mordax (Mitchill)	Rainbow smelt
PCHR	Clupea harengus pallasi Valenciennes	Pacific herring
BRBT	Lota lota (Linnaeus)	Burbot
SFCD	Eliginus gracilis (Tilesius)	Saffron cod
FHSC	Myoxcephalus quadricornis (Linnaeus)	Fourhorn sculpin
ARFL	Liopsetta glacialis (Pallas)	Arctic flounder

Names taken from McAllister et al. (1987).

Table 4. Maturity code.

Female	Male	Maturity
1	6	Immature
2	7	Maturing
3	8	Mature
4	9	Ripe
5	10	Spent
0		Sex indistinguishable

Table 5. Catch and size data for fish captured in gillnets from Station 85050, March 26-27, lift n = 1.

SPECIES	MEAN LENGTH (mm)	MEAN WEIGHT (g)		MESH SIZE 10	19	35	45	55	60	TOTAL	CPUE
FHSC	199.3	53.0	N	0	0	3	0	0	0	3	.13
			%	0	0	60.0	0	0	0		
SCULPIN	155.0	19.0*	N	0	2	0	0	0	0	2	.09
			%	0	40.0	0	0	0	0		

* N=1 for weight average

Table 6. Catch and size data for fish captured in gillnets from Station 86030, May 16-23, lift n = 6.

SPECIES	MEAN LENGTH (mm)	MEAN WEIGHT (g)		MESH SIZE N/A	10	19	33	45	55	60	TOTAL	CPUE
ARCS[1]	302.0	295.0	N	1	0	11	8	0	0	0	20	.12
			%	0.7	0	7.2	5.2	0	0	0		
FHSC	210.2	70.8	N	0	6	24	43	5	12	6	96	.55
			%	0	3.9	15.7	28.1	3.3	7.8	3.9		
SFCD	400.5	434.9	N	0	0	1	11	0	0	1	13	.08
			%	0	0	0.7	7.2	0	0	0.7		
INCO	690.3	3019.4	N	0	0	0	0	1	0	5	6	.03
			%	0	0	0	0	0.7	0	3.3		
RNSM[2]	146.0	31.0	N	0	7	3	0	0	0	0	10	.06
			%	0	4.6	2.0	0	0	0	0		
PCHR	280.5	266.0	N	0	2	0	4	0	0	0	6	.03
			%	0	1.3	0	2.6	0	0	0		
LSCS	203.0	65.0	N	0	1	0	0	0	0	0	1	.01
			%	0	0.7	0	0	0	0	0		
ARFL	139.0	34.4	N	0	0	0	1	0	0	0	1	.01
			%	0	0	0	0.7	0	0	0		

1 N=15 for length and weight averages
2 N=9 for length and weight averages
N/A = Not applicable, mesh size unknown

Table 7. Catch and size data for fish captured in gillnets from Station 86031, May 17-23, lift n = 5.

SPECIES	MEAN LENGTH (mm)	MEAN WEIGHT (g)		MESH SIZE (mm) 10	19	33	45	55	60	TOTAL	CPUE
ARCS	291.6	259.5	N	0	5	5	1	0	0	11	.09
			%	0	7.5	7.5	1.5	0	0		
FHSC	282.0	191.3	N	0	1	0	1	1	0	3	.02
			%	0	1.5	0	1.5	1.5	0		
INCO	455.8	1059.2	N	1	2	2	2	0	1	8	.06
			%	1.5	3.0	3.0	3.0	0	1.5		
RNSM*	233.0	110.0	N	9	23	5	1	0	0	38	.25
			%	13.4	34.3	7.5	0	0	0		
BRBT	707.3	2080.7	N	1	2	1	0	0	0	4	.03
			%	1.5	3.0	1.5	0	0	0		
PCHR	290.0	201.9	N	0	0	1	0	0	0	1	<.01
			%	0	0	1.5	0	0	0		
LSCS	191.0	54.5	N	0	2	0	0	0	0	2	<.01
			%	0	3.0	0	0	0	0		

* N=36 for length and weight averages

Table 8. Catch and size data for fish captured in gillnets from Station 87011, May 13-18, lifts n = 5.

SPECIES	MEAN LENGTH (mm)	MEAN WEIGHT (g)		MESH SIZE N/A	10	19	33	45	55	60	TOTAL	CPUE
ARCS	312.3	312.8	N	0	0	1	11	0	0	0	12	.11
			%	0	0	1.3	14.3	0	0	0		
INCO	530.1	1475.1	N	0	0	1	3	1	3	1	9	.08
			%	0	0	1.3	3.9	1.3	3.9	1.3		
FHSC	257.7	147.8	N	0	0	2	1	2	1	0	6	.05
			%	0	0	2.6	1.3	2.6	1.3	0		
RNSM	221.7	93.0*	N	2	11	21	4	2	0	1	41	.36
			%	2.6	14.3	27.3	5.2	2.6	0	1.3		
LSCS	234.7	122.3	N	0	0	3	0	0	0	0	3	.03
			%	0	0	3.9	0	0	0	0		
LKWF	320.7	378.0	N	0	0	0	1	2	0	0	3	.03
			%	0	0	0	1.3	2.6	0	0		
BRBT	720.3	2394.0	N	0	0	1	0	1	0	1	3	.03
			%	0	0	1.3	0	1.3	0	1.3		

* N=37 for weight average

Table 9. Length-frequency distribution for fourhorn sculpin captured by gillnet, in 1985, Station 85050, 1986, Stations 86030 and 86031, and 1987, Station 87011.

FORK LENGTH (mm)	85050		86030		86031		87011	
	NO.	%	NO.	%	NO.	%	NO.	%
130-139	0	0	1	1.0	0	0	0	0
140-149	0	0	0	0	0	0	0	0
150-159	0	0	1	1.0	0	0	0	0
160-169	0	0	3	3.1	0	0	0	0
170-179	0	0	7	7.3	0	0	0	0
180-189	1	33.3	5	5.2	0	0	0	0
190-199	1	33.3	10	10.4	0	0	0	0
200-209	0	0	20	20.1	0	0	0	0
210-219	1	33.3	18	18.8	0	0	1	16.7
220-229	0	0	16	16.7	0	0	1	16.7
230-239	0	0	5	5.2	0	0	2	33.3
240-249	0	0	5	5.2	0	0	0	0
250-259	0	0	3	3.1	0	0	0	0
260-269	0	0	0	0	0	0	1	16.7
270-279	0	0	1	1.0	2	66.7	0	0
280-289	0	0	2	2.1	0	0	0	0
290-299	0	0	0	0	1	33.3	0	0
300-309	0	0	0	0	0	0	0	0
360-369	0	0	0	0	0	0	1	16.7

Table 10. Length frequency distribution by age group for fourhorn sculpins captured in the Mackenzie River estuary, May, 1986 and 1987.

Length Class	Age (yrs) 3	4	5	6	7	8	9	10	11	12	13	Total
130-139	1											1
140-149												0
150-159			1									1
160-169		2	1									3
170-179		1	3	1	1	1						7
180-189			2	1	1							4
190-199		1		2	2	1						6
200-209			1	3	3							7
210-219				1	4	2	1		1			9
220-229				1	1	1						3
230-239						2	1					3
240-249						2			2			4
250-259						1		1				2
260-269						1						1
270-279							1	1		1		3
280-289									1		1	2
290-299									1			1
300-309												0
360-369											1	1
Total	1	4	8	9	12	11	3	2	5	1	2	58

Table 11. Life history data for fourhorn sculpins captured by gillnet in the Mackenzie River estuary, March, 1985, and May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
3	85050	35	217	63	6				
4	85050	35	188	46	6				
5	85050	35	193	50	6				
5	86030	19	197	51	6				
6	86030	19	208	61	6	7			
7	86030	19	213	57	2	7			
10	86030	19	185	44	6	7			
11	86030	19	177	42	6	8			
12	86030	33	229	82	6	8			
13	86030	33	248	110	2	8			
14	86030	33	220	86	6				
15	86030	33	207	68	2				
33	86030	10	176	38	7	5			0.25
34	86030	19	174	44	5	6			0.92
35	86030	19	201	64	7	7			0.31
36	86030	19	166	34	7	4			0.15
37	86030	19	162	29	10	4			0.15
38	86030	19	190	49	7	6			0.34
40	86030	33	190	55	10	7			0.34
41	86030	33	189	59	8				0.38
42	86030	33	185	58	6	5			
45	86030	33	190	46	6	4			
48	86030	33	207	74					
49	86030	33	245	140	7	8			3.57
52	86030	33	208	67	1	6			
54	86030	65	191	51	5	7			
61	86030	33	169	38	6	5			
62	86030	33	220	100					
63	86030	33	215	75	5	8			
66	86030	19	175	39	6	5			
67	86030	19	212	72	10	7			
68	86030	19	135	17	6				
75	86030	10	200	65					0.41
76	86030	10	212	65	10	8			0.40
77	86030	10	186	44	2	5			1.42
78	86030	10	242	96	5	11			3.10
86	86031	19	277	192	7	9			5.62
93	86031	45	296	226	7	11			5.61
106	86030	19	202	58	6	6			0.28
109	86030	35	200	51		7			0.27
110	86030	35	207	64	1				
111	86030	35	215	85	0	6			
112	86030	55	232	96	0	9			
113	86030	55	211	69	0				
114	86030	55	285	150	5	13			3.70

Table 11. Continued.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
115	86030	65	174	30	5	4			0.37
116	86030	55	208	68	8				0.31
117	86030	55	219	67	8	11			0.30
118	86030	55	228	86	5	7			1.55
119	86030	19	197	51	7	8			0.39
120	86030	19	215	76	5	9			1.25
123	86030	10	207	53	6	5			
125	86030	33	187	50	6	6			0.38
126	86030	33	214	58	10	7			
127	86030	33	207	59	10				
128	86030	33	211	66	7				
129	86030	33	170	34	10	5			
130	86030	33	200	65	7	6			
131	86030	33	258	114	5	10			
163	86031	55	273	156	F	10			
171	86030	19	174	40	0	7			
172	86030	19	220	82	10			0.15	
173	86030	19	210	60					
174	86030	19	220	74	0				
175	86030	19	220	75	0				
176	86030	19	230	72	5				1.37
177	86030	19	209	79	5				1.07
178	86030	19	221	72	0				
184	86030	33	216	67	5				1.02
185	86030	33	221	66	0				0.23
186	86030	33	220	80	10				1.13
187	86030	33	226	84	5				1.06
188	86030	33	210	62	0				
189	86030	33	254	111	10	8			1.01
190	86030	33	232	93	0				
191	86030	33	247	107	5	11			1.28
192	86030	33	195	53	5				0.74
193	86030	33	196	51	5				0.63
194	86030	33	225	87	5				0.71
195	86030	33	216	69	0				
196	86030	33	205	65	5				1.25
197	86030	33	225	84	5				1.22
198	86030	33	230	80	5				1.02
199	86030	33	228	70	10				0.41
200	86030	33	156	30	5	5			0.30
201	86030	33	219	88	5				1.29
202	86030	33	240	94					
203	86030	45	205	66	10				0.94
204	86030	45	214	77	0				
205	86030	45	209	63	6				
206	86030	45	257	139	5				2.27

Table 11. Continued.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
207	86030	45	202	57	6				
209	86030	55	280	180	5	11			2.76
210	86030	55	270	164	5	12			2.03
211	86030	55	207	56	5				0.66
212	86030	55	238	101	0				
213	86030	55	210	71	5				0.48
214	86030	55	190	53	5	6			
215	86030	65	215	81	0				
216	86030	65	229	86	5				1.44
217	86030	65	204	57	5				0.78
218	86030	65	212	77	1				
8	87011	33	225	101	5	6	1.28	0.98	
12	87011	19	365	400	5	13	4.54	5.59	
40	87011	45	238	95	5	8	1.07	1.28	
58	87011	55	239	96	0	8			
67	87011	19	264	120	5	8	1.16	1.37	
73	87011	45	215	75	5	7	1.40	1.19	

F = Female

Table 12. Length-frequency distribution for rainbow smelt captured by gill-net, in 1986, Stations 86030 and 86031, and 1987, Station 87011.

FORK LENGTH (mm)	86030 NO.	86030 %	86031 NO.	86031 %	87011 NO.	87011 %
NM	1	10.0	2	5.3	0	0
110-119	1	10.0	0	0	0	0
120-129	4	40.0	0	0	0	0
130-139	1	10.0	0	0	0	0
140-149	1	10.0	0	0	0	0
150-159	0	0	0	0	1	2.4
160-169	0	0	0	0	0	0
170-179	0	0	0	0	1	2.4
180-189	0	0	0	0	3	7.3
190-199	0	0	0	0	3	7.3
200-209	0	0	2	5.3	1	2.4
210-219	1	10.0	8	21.1	6	14.6
220-229	1	10.0	6	15.8	12	29.3
230-239	0	0	8	21.1	6	14.6
240-249	0	0	5	13.2	3	7.3
250-259	0	0	4	10.5	2	4.9
260-269	0	0	2	5.3	3	2.4
300-309	0	0	1	2.6	0	0

NM = No measurement taken

Table 13. Length-frequency distribution by age groups for rainbow smelt captured in the Mackenzie River estuary, May 1986 and 1987.

Length Class	Age (yrs) 3	4	5	6	7	8	9	10	11	12	Total
110-119	1										1
120-129	3										3
130-139		1									1
140-149	1										1
150-159			1								1
160-169											0
170-179			1								1
180-189			3								3
190-199			1		2						3
200-209				2							2
210-219				6	5	2					13
220-229				2	6	1		1			10
230-239					2	2	4				8
240-249					1	3	3				7
250-259						1	2	1	1		5
260-269							2	1	2		5
270-279											0
280-289											0
290-299											0
300-309										1	1
Total	5	1	6	10	16	9	11	3	3	1	65

Table 14. Life history data for rainbow smelt captured by gillnet in the Mackenzie River estuary, May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
23	86031	33	238	107	8				1.78
25	86031	19	239	116	3				19.68
26	86031	19	241	110	3	8			16.23
27	86031	19	262	166	3	10			21.43
28	86031	19	221	83	7	7			1.89
29	86031	19	240	107	3	8			15.59
31	86031	10	250	142	3				19.15
69	86030	10	131	19	6	4			
70	86030	10	122	12	6	3			
71	86030	10	113	10	1	3			
72	86030	10	122	12	0	3			
73	86030	10	141	21	1	3			
74	86030	10	120	11					
79	86031	10	255	145	3	9			24.05
80	86031	10	222	96	7	7			2.47
81	86031	10	213	82	3	6			12.76
82	86031	19	215	78	3	7			12.15
83	86031	19	257	134	8	9			2.72
84	86031	19	242	123	8	8			2.24
85	86031	19	203	70	3	6			12.24
88	86031	19	217	92	3	7			13.47
89	86031	19	237	117	3				13.97
90	86031	33	235	111	8	9			2.09
91	86031	45	304	234	3	12			30.23
94	86031	19	228	116	8				2.24
95	86031	19	241	128	3	9			18.78
96	86031	19	262	154	3	9			
97	86031	19	224	82	7	7			2.20
102	86030	19	219	78	6	6			0.43
121	86030	19	229	100	8	7			4.21
122	86030	19			8				
124	86030	10	120	12	0	3			
133	86031	10	214	78	3				12.48
134	86031	19	216	94	3	6			16.23
135	86031	33	239	109	3				
140	86031	10	226	105	8				1.95
141	86031	10	213	109	8	8			2.66
142	86031	10	220	87	8	6			1.31
143	86031	10	215	86	8	6			1.86
149	86031	19							
150	86031	19							
151	86031	19	251	129	3	8			21.81
152	86031	19	231	108	3	8			15.28
153	86031	19	232	102	3	9			13.98
154	86031	19	215	77	6	6			0.44

Table 14. Continued.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
155	86031	19	206	68	7	6			1.28
159	86031	33	241	124	3				
160	86031	33	231	90	7				0.98
10	87011	19	231	98	3	7	12.20	7.65	
11	87011	19	218	86	8	8	1.54	0.81	
13	87011	10	224	107	3				10.50
14	87011	10	155	26	0	5			
15	87011	10	224	122	8	10	2.05	0.51	
16	87011	10	180	41	0	5			
17	87011	10	242	121	8	9			2.15
18	87011	19	228	93	8		1.83	0.55	
22	87011	10	260	130	8	9	2.49	1.26	
23	87011	19	182			5			
24	87011	19	235	111	3				16.86
25	87011	19	213	80	6	6	0.17	0.08	
26	87011	19	247	89	8	7	1.25	0.93	
27	87011	19	258	148	3	11			24.74
28	87011	19	242	100	8	9	2.93	1.02	
29	87011	19	228	101	3				15.13
30	87011	19	225	93	6				
31	87011	19	223	88	8	6	1.69	0.51	
32	87011	19	180	46	3	5			5.10
33	87011	19	215	81	3	7			14.60
34	87011	19	253	125	8	10	2.82	0.75	
42	87011	10	220	77	3				
43	87011	10	175	33	0	5			
44	87011	19	204						
45	87011	19	224	86	8		1.68	0.87	
46	87011	19	219		3	7			
47	87011	19	266	156	3	11	15.93	6.50	
51	87011	33	238	117	3	7	13.34	4.00	
59	87011	65	227	90	8	8	1.58	0.91	
60	87011	10	193	52	6	7	0.12		
61	87011	10	220	80	3	7	7.22	4.95	
62	87011	10	210	82	3		7.43	5.93	
63	87011	19	229	108	3	7	9.45	8.33	
65	87011	19	230	96	8	8	2.15	0.87	
66	87011		228	94	8		2.16	0.98	
68	87011	45	239		8	9	1.61	0.71	
69	87011	45	266	172	3	11	25.89	5.81	
70	87011		238	121	3	9	16.24	5.85	
74	87011	33	213	87	3	7	11.95	2.90	
75	87011	33	192	57	6	7	0.07	0.04	
76	87011	33	197	64	8	5	1.16	0.58	

Table 15. Length-frequency distribution for Pacific herring captured by gillnet, in 1986, Stations 86030 and 86031.

FORK LENGTH (mm)	86030 NO.	86030 %	86031 NO.	86031 %
230-239	1	16.7	0	0
240-249	0	0	0	0
250-259	1	16.7	0	0
260-269	1	16.7	0	0
270-279	1	16.7	0	0
280-289	0	0	0	0
290-299	0	0	1	100
300-309	1	16.7	0	0
350-359	1	16.7	0	0

Table 16. Life history data for Pacific herring captured by gillnet in the Mackenzie River estuary, May, 1986.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
39	86030	33	250	162	6				
44	86030	33	307	320	7	9			16.80
46	86030	33	358	508	3	11			69.36
107	86030	33	272	277	3				45.31
136	86031	33	290	202	3	12			
165	86030	10	265	212		9			
166	86030	10	231	117					

Table 17. Length-frequency distribution for saffron cod captured by gillnet, in 1986, at Station 86030.

FORK LENGTH (mm)	86030 NO.	86030 %
340-349	1	7.7
350-359	0	0
360-369	0	0
370-379	0	0
380-389	1	7.7
390-399	6	46.2
400-409	2	15.4
410-419	1	7.7
420-429	0	0
430-439	1	7.7
440-449	1	7.7

Table 18. Life history data for saffron cod captured by gillnet in the Mackenzie River estuary, May, 1986.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
16	86030	33	399	461		9			
17	86030	33	397	424	8	10			9.46
43	86030	33	415	529	7	10			13.57
50	86030	33	395	388	7	10			13.35
51	86030	33	409	446		14			
59	86030	33	442	482	7	14			
60	86030	33	436	472	6	13			
170	86030	19	400	463					
179	86030	33	391	440					
180	86030	33	397	440	M	9			
181	86030	33	384	367		9			
182	86030	33	397	427		10			
219	86030	65	345	315					

M = Male

Table 19. Length-frquency distribution of burbot captured by gillnet, in 1986, at Station 86031, and 1987, at Station 87011.

FORK LENGTH (mm)	86031 NO.	86031 %	87011 NO.	87011 %
660-669	1	25.0	0	0
670-679	0	0	0	0
680-689	1	25.0	0	0
690-699	0	0	0	0
700-709	1	25.0	2	66.7
710-719	0	0	0	0
720-729	0	0	0	0
730-739	0	0	0	0
740-749	0	0	0	0
750-759	0	0	1	33.3
760-769	0	0	0	0
770-779	1	25.0	0	0

Table 20. Life history data for burbot captured by gillnet in the Mackenzie River estuary, May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
30	86031	19	770	2562	7	11			23.62
32	86031	10	705	2081	6	11			
100	86031	19	688	1893					
138	86031	33	666	1788	6	10			
35	87011	19	707	2108	5	13	7.96	7.01	
41	87011	60	753	2911	2	12	7.74	8.52	
56	87011	45	701	2163	7	12	1.85	1.67	

Table 21. Length-frequency distribution for inconnu captured by gillnet in 1986, Stations 86030 and 86031, and 1987, Station 87011.

FORK LENGTH (mm)	86030 NO.	86030 %	86031 NO.	86031 %	87011 NO.	87011 %
275-299	0	0	1	12.5	0	0
300-324	0	0	0	0	0	0
325-349	0	0	0	0	0	0
350-374	0	0	2	25.0	1	11.0
375-399	0	0	1	12.5	1	11.0
400-424	0	0	0	0	0	0
425-449	0	0	0	0	1	11.0
450-474	0	0	1	12.5	0	0
475-499	0	0	0	0	1	11.0
500-524	0	0	0	0	1	11.0
525-549	0	0	0	0	0	0
550-574	0	0	0	0	0	0
575-599	1	16.7	2	25.0	0	0
600-624	0	0	1	12.5	2	22.0
625-649	0	0	0	0	1	11.0
650-674	2	33.3	0	0	0	0
675-699	0	0	0	0	0	0
700-724	1	16.7	0	0	1	11.0
725-749	0	0	0	0	0	0
750-774	2	33.3	0	0	0	0

Table 22. Life history data for inconnu captured by gillnet in the Mackenzie River estuary, May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
21	86031	33	393	500					
55	86030	65	770	3880					
56	86030	65	660	2337					
57	86030	65	661	2451					
58	86030	65	714	3335					
92	86031	45	450	844					
98	86031	19	355	432					
139	86031	10	358	390					
144	86031	19	620	2167					
156	86031	33	590	1907					
162	86031	45	295	223	6	7			
164	86031	65	585	2010					
208	86030	45	758	4300					
220	86030	65	579	1813					
1	87011	60	705	3130	5	14	4.73	6.84	
2	87011	55	490	1005	1	13	1.00	0.90	
3	87011	45	522	1249	6	12	0.11	0.15	
21	87011	55	607	1973	5	14	3.30	2.71	
36	87011	33	389	500	1	8	0.36	0.32	
50	87011	19	426	655	7	8	0.49	0.40	
52	87011	33	369	419	6	9	0.02	0.02	
57	87011	55	623	2052	2	12	3.52	2.54	
77	87011	33	640	2293	6	14	0.62	0.68	

Table 23. Length-frequency distribution for Arctic cisco captured by gill-net, in 1986, Stations 86030 and 86031, and 1987, Station 87011.

FORK LENGTH (mm)	86030 NO.	86030 %	86031 NO.	86031 %	87011 NO.	87011 %
NM	5	25.0	0	0	0	0
170-179	1	5.0	0	0	0	0
180-189	0	0	0	0	0	0
190-199	0	0	0	0	1	8.3
200-209	0	0	0	0	0	0
210-219	0	0	1	10.0	0	0
220-229	1	5.0	0	0	0	0
230-239	0	0	0	0	0	0
240-249	0	0	1	10.0	0	0
250-259	0	0	0	0	0	0
260-269	0	0	2	20.0	0	0
270-279	1	5.0	0	0	0	0
280-289	2	10.0	0	0	0	0
290-299	0	0	0	0	0	0
300-309	2	10.0	0	0	3	25.0
310-319	0	0	0	0	2	16.7
320-329	2	10.0	1	10.0	2	16.7
330-339	4	20.0	3	30.0	2	16.7
340-349	1	5.0	1	10.0	1	8.3
350-359	0	1	1	10.0	1	8.3
360-369	1	5.0	0	0	0	0

NM = No measurement taken

Table 24. Life history data for Arctic cisco captured by gillnet in the Mackenzie River estuary, May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
1	86030	19	331	395					
2	86030	19	332	394					
3	86030	19	305	265					
8	86030	19	360	530					
9	86030	19	289	223					
18	86030	33	342	378					
19	86030	33	336	393					
20	86030		320	324					
22	86031	33	347	389					
24	86031	19	246	145					
47	86030	33	323	316					
53	86030	33							
64	86030	33							
65	86030	33							
87	86031	19	216	91	6	4			
99	86031	19	262	172					
101	86031	33	327	336					
103	86030	19	179	49					
104	86030	19	222	116					
105	86030	19	278	200					
108	86030	33	332	374					
132	86030	33	300	250					
137	86031	33	333	358					
145	86031	19	262	165					
147	86031	19	196	53					
157	86031	33	338	358					
158	86031	33	330	334					
161	86031	45	350	454					
167	86030	19	281	216	6	8			0.73
168	86030	19							
169	86030	19							
4	87011	33	315	328	6	11	0.09	0.10	
5	87011	33	317	303	6	8	0.15	0.09	
6	87011	33	320	350	6	7	0.20	0.10	
7	87011	33	337	435	7	9	0.67	0.51	
9	87011	33	329	383	6	9	0.02	0.02	
37	87011	33	330	283	7	9	0.43	0.42	
38	87011	33	351	406	3	11	2.82	3.77	
39	87011	33	307	272	6	9	0.12	0.10	
53	87011	33	302	260	5	9	0.59	0.48	
54	87011	33	340	399	2	11	2.78	2.06	
55	87011	33	302	263	6	6	0.09	0.05	
64	87011	19	197	71	6	5	0.08	0.05	

Table 25. Life history data for least cisco captured by gillnet in the Mackenzie River estuary, May, 1986 and 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
4	86030	19	203	65					
146	86031	19	210	66					
148	86031	19	172	42					
19	87011	19	201	62	6	6	0.02	0.04	
48	87011	19	221	87	6	7	0.05	0.06	
49	87011	19	282	218	2	8	2.87	2.14	

Table 26. Life history data for lake whitefish captured by gillnet in the Mackenzie River estuary, May, 1987.

Sample Number	Station	Mesh Size	Length (mm)	Weight (g)	Maturity Code	Age	Gonad Weight Left	Gonad Weight Right	Total Gonad Weight
20	87011	33	309	329	6	9	0.36	0.27	
71	87011	45	328	421	2	9	1.91	1.43	
72	87011	45	325	384		7			